DOCUMENT RESUME

ED 042 594 RE 003 139


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|---|---|
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| TITLE | Learnability vs. Readability of Texts. |
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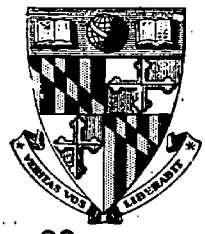
| SPONS AGENCY | Department of Health, Education, and Welfare, Washington, D.C. National Center for Educational Research and Development. |
| REPORT NO | R-80 |
| BUREAU NO | BR-6-1610 |
| PUB DATE | Sep 70 |
| GRANT | OEG-2-7-061610-0207 |
| NOTE | 70p. |
| EDRS PRICE | EDRS Price MF-$0.50 HC-$3.60 |
| DESCRIPTORS | Comprehension, *Grade 6, *Learning, *Readability, *Reading Comprehension, Reading Level, Reading Materials, *Textbook Evaluation, Word Recognition |



ABSTRACT

A distinction is made between the learnability and readability of text materials. Learnability refers to the extent to which new learning results from reading a passage; readability refers to the extent to which a passage is comprehended. Cleraly, comprehension can occur without new learning. Classic readability formulas use text characteristics such as word difficulty and sentence length to predict comprehension. In this study, the prediction of new learning with a variety of text variables was examined. Sixty-two sixth-grade subjects read 11 passages ranging from second- to twelfth-grade difficulty. Learning scores were based on two types of pretests and post-tests. The results of stepwise regression analyses of text characteristics on learning scores revealed that the same characteristics, including word difficulty and sentence length, which predict comprehension also predict new learning. However, more than one text characteristic in a multiple regression equation did not significantly improve the predictability over the zero order correlation. Thus, classic readability formulas may be used to estimate the learnability as well as the readability of text materials. (Author/NH)




THE JOHNS HOPKINS UNIVERSITY

REPORT No. 80



# LEARNABILITY VERSUS READABILITY OF TEXTS

BY

JOHN T. GUTHRIE

SEPTEMBER, 1970

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# LEARNABILITY VERSUS READABILITY OF TEXTS

John T. Guthrie

September, 1970

Published by the Center for Social Organization of Schools, supported in part as a research and development center by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed in this publication do not necessarily reflect the position or policy of the Office of Education, and no official endorsement by the Office of Education should be inferred.

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ACKNOWLEDGMENT

The author gratefully acknowledges the assistance of Dana Gleicher in preparing the materials, collecting the data, and analysing the findings of this study.

The cooperation of the administrators, teachers and children in a Catholic elementary school in Baltimore is also noted with appreciation.

ABSTRACT

A distinction is made between the learnability and readability of text materials. Learnability refers to the extent to which new learning results from reading a passage; readability refers to the extent to which a passage is comprehended. Clearly, comprehension can occur without new learning. Classic readability formulas use text characteristics such as word difficulty and sentence length to predict comprehension. In this study the prediction of new learning with a variety of text variables was examined. Sixty-two sixth grade subjects read 11 passages ranging from second to twelfth grade difficulty. Learning scores were based on two types of pre tests and post tests. The results of stepwise regression analyses of text characteristics on learning scores revealed that the same characteristics, including word difficulty and sentence length which predict comprehension also predict new learning. However, more than one text characteristic in a multiple regression equation did not significantly improve the predictability over the zero order correlation. Thus, the classic readability formulas may be used to estimate the learnability as well as the readability of text materials.

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## Introduction

Newspapermen in the early 1940's were keenly interested in the readability of the front pages of their newspapers. The ease and accuracy with which the front page communicated its message was considered to be the vital characteristic of a noteworthy newspaper. In order to develop quality control of the communication effectiveness of newspapers, readability formulas were constructed and used widely. Early formulas were developed by Flesch (1943), Lorge (1944) and Dale & Chall (1948); more recent indices have been devised by Bormuth (1966), Szalay (1965) and Coleman & Miller (1968). As well as being popular among newsmen, readability formulas have enjoyed the endorsement of text book publishers and the reliance of teachers and administrators. The formulas are used commonly in the description of text books as appropriate for one grade or another and in the selection of reading materials by teachers and administrators.

Central to this investigation is a distinction between the readability and learnability of written materials. The learnability of a passage refers to the extent to which new learning results from reading the passage. The new learning may be assessed by obtaining a measure of the increase in knowledge or information that results from reading the passage. This measure requires the administration of a pre test and post test to subjects. On the other hand, readability refers to whether a given passage is comprehended. Comprehension may be measured

simply by administering test questions after the relevant material has been read. Note that the term comprehension refers to post test performance only; whereas the term learning refers to the difference between post test and pre test performances. Bearing in mind the difference between comprehension and learning, it is apparent that a person may comprehend a certain passage without learning anything from it. For example, one could understand a paragraph that describes bicycles without acquiring any new knowledge or information that he did not know before reading the passage.

Learnability refers to the capacity of a passage to impart new learning; whereas readability refers to the capacity of the passage to engender comprehension. Since new learning and comprehension are distinctly different consequences of reading a passage, the learnability and readability of a passage may each have their own unique characteristics. The aim of this investigation was to examine the extent to which existing readability formulas may be used to estimate the learnability as well as the readability of text materials. It is possible that different formulas are needed for prediction of learnability than those which are used for the estimation of readability. However, it is also possible that the same formulas can be used for both purposes and the existing readability formulas may be viewed as valid for the prediction of new learning. This study thus may be viewed as an attempt to validate the readability formulas for the purpose of predicting learnability.

The Dale-Chall (1948) readability index has long served as a tool for practitioners and researchers. The formula is:

$$X_{c_{50}} = .1579X_1 + .0496X_2 + 3.6365,$$

where

$X_{c_{50}}$ = the reading grade of pupils who can answer 50 percent of the questions over a passage

$X_1$ = word difficulty (number of words not included on the Dale list of 3,000 words)

$X_2$ = average sentence length.

Inspection of this formula indicates that the characteristics of a given passage, viz., word difficulty and sentence length, are used to predict the reading ability of pupils who can answer questions over the passage correctly. This implies that for students of a given reading ability, passages with relatively easy words and short sentences are comprehended more fully than passages with difficult words and long sentences. However, this does not mean that more is learned from passages containing easy words and short sentences. It is possible that the superior comprehension for these passages derives from the fact that students possess more information about these passages before they are read than they possess about other passages. The total amount of new learning for the two types of passages may be the same. The variables in the Dale-Chall formulas thus predict total comprehension of a passage rather than new learning. Whether the variables also predict new learning will be determined in this study.

Several new linguistic characteristics of prose passages have been used by Bormuth (1966) to establish new readability formulas. The criterion for comprehension of the passages used in Bormuth's study was performance on a cloze test administered before the subjects had

read the passages. A cloze test (Taylor, 1957) consists of requiring the examinee to fill in the blanks in a passage in which every fifth word has been deleted. A cloze test which is given before the individuals have read the relevant passage will be termed a pre cloze test. Likewise, a cloze test given after reading will be termed a post cloze test. It is apparent that the validity of the pre cloze test, as a measure of comprehension, is questionable.

In an attempt to validate the pre cloze test as a comprehension measure, Bormuth (1967) conducted the following investigation. Subjects were given a pre cloze test; they were then given the passage to read and finally they were given a post multiple choice test over the passage. The correlation of the pre cloze and the post multiple choice was above .90 and was claimed to establish the validity of the pre cloze test. However, the administration of the pre cloze must have affected the post multiple choice test scores. Consequently, the post multiple choice test is not an adequate criterion on which to validate the pre cloze test as a measure of comprehension. Furthermore, although Bormuth's (1966) variables appear to predict the pre cloze performance on a passage, it is unknown whether these variables predict new learning from the passage.

A method for assessing the amount of new information which is transmitted by prose materials has been proposed by Coleman & Miller (1968). These investigators employed a technique developed from an information theory rationale. Subjects were first given a pre test which required them to attempt to guess each word in a passage in succession. The subjects were permitted one guess and were then given the correct word regardless of whether their guess was correct or incorrect. After completing the passage, the subjects were given a

post test which was identical to the pre test. The difference in the number of correct guesses between the pre test and post test was proposed as a measure of information transmitted by the passage. This measure is not adequate, however, to reflect the substantive learning that occurs from reading. This measure appears to rely too heavily on short term memory, special grammatical abilities, and verbal encoding. Educators are concerned with the student's acquisition of meaningful concepts, and the ability to answer questions over reading material, rather than the word guessing skills required by this task. Thus the measure does not possess satisfactory face validity and the predictive validity of the measure was not assessed by correlating it with any other measure of learning.

The intent of the present study was to examine the readability indexes used by other investigators. Two measures of new learning and two measures of comprehension were constructed. These measures of learning and comprehension were correlated with the characteristics of prose which are used in extant readability formulas.

## Method

Subjects. The subjects in this study were 62 sixth grade children attending a Catholic elementary school in Baltimore. The mean chronological age of the children was 11.74 years with a standard deviation of 1.56 years. The average Lorge-Thorndike IQ administered six months prior to the study was 107.90 with a standard deviation of 11.33. The mean reading comprehension of the group as measured by the comprehension subtest of the Iowa Test of Basic Skills administered six months previous

to the study was 6.29 with a standard deviation of 1.21 in grade equivalent terms. Socio-economic status of the subjects was determined by obtaining the occupations of the members of the household and rating these occupations according to the Hollingshead occupational scale (Hollingshead & Redlich, 1958). The seven levels of the scale include: 1) executives and proprietors of large concerns, and major professionals; 2) managers and proprietors of medium-sized businesses and lesser professionals; 3) administrative personnel of large concerns, owners of small independent businesses and semi-professionals; 4) owners of little businesses, clerical and sales workers, and technicians; 5) skilled workers; 6) semi-skilled workers and 7) unskilled workers. The mean and standard deviation of the group in terms of this scale were 3.31 and 1.37 respectively. A summary of these data are shown in Table 1.

TABLE 1

Demographic and Cognitive Characteristics of Children in the Sample

| Characteristic | Mean | Standard Deviation |
|---|---|---|
| Chronological Age (years) | 11.73 | 1.56 |
| Lorge-Thorndike IQ | 107.90 | 11.33 |
| Iowa Test of Basic Skills - Reading Comprehension (grade equivalent) | 6.29 | 1.21 |
| Iowa Test of Basic Skills - Vocabulary (grade equivalent) | 6.71 | 1.22 |
| Socio-economic Status (Hollingshead Occupational Scale) | 3.31 | 1.37 |

Materials. The reading materials were drawn from textbooks and readers which are commonly used in elementary and high schools. The materials were selected to represent difficulty levels from second to twelfth grade according to the Dale-Chall readability index. Since the Dale-Chall does not provide grade equivalents below fourth grade, the second and third grade passages were based on an extrapolation from the Dale-Chall. The content of the passages included history, science, biography and fiction. The passages ranged in length from 89 to 150 words. All of the selections are included in Appendix B.

For each passage a multiple choice test was constructed which contained eight items with four alternatives. The items required both the recall of facts and the identification of the main ideas. Care was taken to construct the test items at the sixth grade level of difficulty regardless of the grade level of the passage for which the item was written. The multiple choice tests are available for inspection in Appendix C. Cloze tests were also constructed for each passage. The cloze tests consisted of the original passages with every fifth word deleted. The subjects' task was to fill in the deleted words. These tests are presented in Appendix D.

Testing Groups. Four groups were formed from the sample. Group 1 was given the multiple choice items on all of the passages as a pre test. The testing was group paced such that all subjects spent the same amount of time on the tests for each of the passages. One week later this group was given the passages to read and the same items to answer as a post test. The reading and testing was alternated through the sequence of paragraphs. For instance, the paragraph at the second grade level was read and the eight multiple choice items on that

paragraph were then taken; the third grade paragraph was read and the relevant items were administered. The paragraphs were presented in ascending order of difficulty for all students. Group 2 was given a cloze test as a pre test (pre cloze). This pre cloze was administered over a two day period beginning the same day as the pre multiple choice test. This group was then given the passages to read one week later and the same cloze test was administered as a post cloze. The reading and testing was alternated for this group the same as for group 1. Group 3 was given the reading passages and the multiple choice test as a post test only. The reading and testing were alternated and were given on the same day as for groups 1 and 2. Group 4 was given the passages and the cloze test as a post test (post cloze). The tasks were alternated as for the other groups and administered on the same day as the other groups. Refer to Table 2 for an outline of these groups.

TABLE 2

Formation of Groups for Reading and Testing

| | Day | | | |
|---|---|---|---|---|
| Group | Thursday | Friday | Thursday | N |
| 1. | Pre Multiple Choice | | Read-Post Multiple Choice | 16 |
| 2. | Pre Cloze | Pre Cloze | Read-Post Cloze | 16 |
| 3. | | | Read-Post Multiple Choice | 14 |
| 4. | | | Read-Post Cloze | 16 |

Procedure. The subjects were divided at the median according to reading ability and socio-economic status. From each of the four cells of this 2x2 classification, subjects were assigned at random to the four testing groups. The subjects in groups 1 and 2 were paced through the pre tests by the experimenter. All subjects in each group were given the same amount of time on each section of the test. The pre multiple choice test required approximately 40 minutes and the pre cloze required about 80 minutes. During the reading and post testing phase the subjects were group paced through the alternating cycles. All subjects in group 1 were given the same amount of time to read the first paragraph before receiving the test on that paragraph. The same amount of time was given for the test on that paragraph and then all subjects proceeded to the next passage. An identical procedure was used with groups 2, 3 and 4. For the reading and testing phase groups 1 and 3 were run simultaneously by one experimenter while groups 2 and 4 were also run together by a different experimenter. The total time for all groups on this phase was approximately 45 minutes.

## Results

Linguistic characteristics of passages. The passages were first described by examining the linguistic characteristics possessed by each passage. The characteristics are labeled and defined in Table 3 beginning with noun redundancy and ending with pronoun frequency.

TABLE 3

Variables Used to Describe Prose Passages

| Name | Definitions |
|---|---|
| 1. Noun redundancy | 1.00 minus (Number of different nouns/ Total number of nouns) |
| 2. Modifier redundancy | 1.00 minus (Number of different modifiers/ Total number of modifiers) [Modifiers = adjectives + adverbs] |
| 3. Noun abstractness | Number of abstract nouns/Total number of nouns |
| 4. Verb nominalizations | Number of verb nominalizations/Total number of nouns [Verb nominalization = noun formed from verb - operate operation] |
| 5. Verb copula | Number of [to be] verbs/Total number of words |
| 6. Noun familiarity | Mean familiarity of nouns on Thorndike-Lorge J scale. Where a word occurred 1,000 or more times in J count, combined L and S counts used. (Thorndike-Lorge familiarity) |
| 7. Verb familiarity | Thorndike-Lorge familiarity |
| 8. Adjective familiarity | Thorndike-Lorge familiarity |
| 9. Adverb familiarity | Thorndike-Lorge familiarity |
| 10. Word length | Mean number of letters per word |
| 11. Clause length | Mean number of letters per clause |
| 12. Sentence length | Mean number of letters per sentence |
| 13. Word difficulty | 1.00 minus (Number of words on the Dale 3,000 list/Total number of words) |
| 14. Noun frequency | Number of nouns/Total number of words |
| 15. Adjective frequency | Number of adjectives/Total number of words |
| 16. Verb frequency | Number of verbs/Total number of words |
| 17. Adverb frequency | Number of adverbs/Total number of words |
| 18. Pronoun frequency | Number of pronouns/Total number of nouns and pronouns |

The occurrence of the characteristics in the 11 passages used in the study may be observed in Appendix A. In this appendix the columns represent the different passages and the rows contain the linguistic descriptors of the passages. It can be observed that the incidence of two of the characteristics, word difficulty and sentence length, increases regularly as the grade level of the passages increases. This is a result of the fact that these two descriptors are used in the Dale-Chall formula which was used to establish the grade levels of the passages initially.

The intercorrelations of all of the linguistic characteristics across passages are presented in Table 4. It is interesting to note that the two predictors used in the Dale-Chall formula, sentence length and word difficulty, have a correlation of .90. Other variables which were significantly correlated with both word difficulty and sentence length were: abstractness, verb nominalization, clause length, and noun frequency. In addition, word difficulty was significantly correlated with verb frequency, adverb frequency and pronoun frequency. The other characteristics not only failed to correlate with word difficulty, but most of them failed to correlate significantly with each other. The characteristics which did not correlate significantly with word difficulty included: noun redundancy, modifier redundancy, verb copula, noun familiarity, verb familiarity, adjective familiarity, adverb familiarity, word length, and adjective frequency. If any of these variables correlate with the readability of written materials they may be useful additions to the Dale-Chall formula since they are independent of the two variables now employed in the formula.

TABLE 4

Intercorrelation of Linguistic Characteristics in Text Materials

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Noun redundancy | | .41 | -.32 | -.05 | .14 | -.22 |
| 2. Modifier redundancy | | | -.10 | -.01 | -.09 | -.26 |
| 3. Noun abstractness | | | | .61 | -.44 | .26 |
| 4. Verb nominalization | | | | | -.22 | -.11 |
| 5. Verb copula | | | | | | -.49 |
| 6. Noun familiarity | | | | | | |
| 7. Verb familiarity | | | | | | |
| 8. Adjective familiarity | | | | | | |
| 9. Adverb familiarity | | | | | | |
| 10. Word length | | | | | | |
| 11. Clause length | | | | | | |
| 12. Sentence length | | | | | | |
| 13. Word difficulty | | | | | | |
| 14. Noun frequency | | | | | | |
| 15. Adjective frequency | | | | | | |
| 16. Verb frequency | | | | | | |
| 17. Adverb frequency | | | | | | |
| 18. Pronoun frequency | | | | | | |

TABLE 4 (continued)

| | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | -.72* | .49 | -.11 | .32 | -.11 | .02 | 00 | .23 | .20 | .31 | .19 | -.54 |
| 2. | -.39 | .71* | .11 | .50 | .02 | .10 | -.18 | .05 | .24 | -.17 | -.14 | -.13 |
| 3. | .38 | -.36 | -.50 | .40 | .78* | .72* | .88* | .70 | .52 | -.69 | -.63 | -.54 |
| 4. | .26 | .05 | -.40 | .14 | .75* | .84* | .74* | .53 | .43 | -.57 | -.53 | -.46 |
| 5. | .11 | -.01 | -.30 | -.34 | -.57 | -.40 | -.42 | -.53 | -.51 | .71* | .41 | .37 |
| 6. | .04 | .05 | .36 | .16 | .17 | .09 | -.01 | .16 | -.29 | -.17 | .17 | .06 |
| 7. | | -.48 | -.10 | -.38 | .07 | 00 | .12 | -.06 | -.03 | -.27 | .15 | .24 |
| 8. | | | .40 | .31 | -.15 | .10 | -.12 | -.09 | -.17 | .13 | .34 | .06 |
| 9. | | | | -.39 | -.50 | -.52 | -.64 | -.51 | -.24 | .22 | .51 | .51 |
| 10. | | | | | .53 | .57 | .62 | .72* | .32 | -.48 | -.33 | -.56 |
| 11. | | | | | | .90* | .89* | .82* | .54 | -.86* | -.64 | -.62 |
| 12. | | | | | | | .90* | .75* | .39 | -.68 | -.63 | -.58 |
| 13. | | | | | | | | .84* | .64 | -.76* | -.73* | -.73* |
| 14. | | | | | | | | | .68 | -.71* | -.74* | -.89* |
| 15. | | | | | | | | | | -.59 | -.76* | -.78* |
| 16. | | | | | | | | | | | .42 | .44 |
| 17. | | | | | | | | | | | | .81* |
| 18. | | | | | | | | | | | | |

Note.—Each correlation coefficient is based on 11 passages (N = 11). The asterisk indicates that the correlation is significant at $p < .01$.

Learning measures. The central issue of this study is the extent to which learning from text materials can be predicted by the linguistic characteristics of the materials. For this purpose a sensitive measure of learning is needed. The measure adopted for this analysis was the adjusted gain score advocated by DuBois. This statistic may be represented as:

$$\hat{G} = x_2 - r_{12}x_1$$

where

$\hat{G}$ = adjusted gain score

$x_2$ = post test score

$x_1$ = pre test score

$r_{12}$ = correlation of pre test and post test.

Since knowledge about the contents of a passage possessed before the passage is read (pre test score) is subtracted from the student's knowledge about the contents of the passage after the passage has been read (post test score), the gain score is a measure of the change in knowledge or new learning that results as a consequence of reading the passage. Furthermore, this statistic is base-free, meaning that the size of the gain score is independent of the size of the pre test score. The gain score is not inflated or suppressed by the magnitude of the pre test score.

This adjusted gain score was computed individually for each person's score on each passage for experimental groups 1 and 2. Recall that group 1 received a pre multiple choice test, read the passages and then a post multiple choice test. Group 2 received a pre cloze test, read the passages and received a post cloze test. Consequently, two different

scores were obtained, an adjusted gain score for the multiple choice test (multiple choice gain) and the adjusted gain score for the cloze test (cloze gain). For each of the groups, a mean gain score was obtained for each of the 11 passages by averaging the scores of all of the individuals in that group.

Some of the characteristics of the adjusted gain score may be observed by examining the correlation of the adjusted gain scores with the pre test and post test scores for all of the passages. For this analysis, the following mean scores were computed for each passage: pre multiple choice, pre cloze, post multiple choice, post cloze, multiple choice gain and cloze gain. These scores across the 11 passages were then correlated. The intercorrelation matrix is presented in Table 5.

It is reassuring to note in Table 5 that the two pre tests, pre cloze and pre multiple choice had a significant correlation of .73, and the two post tests, post cloze and post multiple choice had a significant correlation of .76. However, the two gain scores, cloze gain and multiple choice gain, were not significantly correlated in this sample. One interpretation of this lack of correlation is that these two measures are assessing fundamentally different types of learning. However, it is also possible that the reliability of the gain scores was lower than the reliability of the pre test or post test scores considered separately. The deflated reliability could prevent the true correlation between the two types of learning from manifesting itself.

TABLE 5

Intercorrelations of Pre Tests, Post Tests, and Adjusted Gain Scores for Passages of Text

| | Pre Cloze | Pre Multiple Choice | Post Cloze | Post Multiple Choice | Cloze Gain | Multiple Choice Gain |
|---|---|---|---|---|---|---|
| Pre Cloze | | .73* | .93* | .70 | .83* | .70 |
| Pre Multiple Choice | | | .74* | .48 | .72* | .41 |
| Post Cloze | | | | .76* | .85* | .68 |
| Post Multiple Choice | | | | | .65 | .95* |
| Cloze Gain | | | | | | .56 |
| Multiple Choice Gain | | | | | | |

Note.—An asterisk indicates a correlation coefficient significant at $p < .01$. Each coefficient is based on 11 passages (N = 11).

Multiple regression of passage characteristics on learning measures. A preliminary step taken before the regression equations were established was the computation of the zero order correlations between the passage characteristics and the tests and gain scores. For each paragraph the scores for each linguistic characteristic were recorded in addition to the obtained means on the pre multiple choice, pre cloze, post multiple choice, post cloze, multiple choice gain, and cloze gain scores. The correlation across passages of each of the tests with each of the linguistic characteristics was then calculated. These correlations may be inspected in Table 6.

TABLE 6

Intercorrelations of Tests with Linguistic Characteristics of Passages

| | Pre Cloze | Pre Multiple Choice | Post Cloze | Post Multiple Choice | Cloze Gain | Multiple Choice Gain |
|---|---|---|---|---|---|---|
| 1. Noun redundancy | .16 | .26 | .01 | .07 | .02 | .10 |
| 2. Modifier redundancy | -.06 | .18 | -.15 | -.29 | -.43 | -.20 |
| 3. Noun abstractness | -.70 | -.63 | -.66 | -.80* | -.59 | -.79* |
| 4. Verb nominalization | -.65 | -.67 | -.79* | -.60 | -.63 | -.42 |
| 5. Verb copula | .39 | .62 | .26 | .27 | .58 | .30 |
| 6. Noun familiarity | -.37 | -.28 | -.09 | -.11 | -.16 | -.23 |
| 7. Verb familiarity | -.05 | -.04 | .02 | -.27 | .21 | -.26 |
| 8. Adjective familiarity | -.03 | .06 | -.12 | -.04 | -.30 | .11 |
| 9. Adverb familiarity | .46 | .23 | .57 | .53 | .20 | .56 |
| 10. Word length | -.57 | -.44 | -.54 | -.57 | -.61 | -.60 |
| 11. Clause length | -.88* | -.83* | -.86* | -.66 | -.81* | -.65 |
| 12. Sentence length | -.87* | -.84* | -.96* | -.78* | -.84* | -.68 |
| 13. Word difficulty | -.77* | -.69 | -.84* | -.87* | -.76* | -.81* |
| 14. Noun frequency | -.61 | -.68 | -.61 | -.63 | -.55 | -.65 |
| 15. Adjective frequency | -.12 | -.34 | -.22 | -.35 | -.38 | -.29 |
| 16. Verb frequency | .68 | .70 | .60 | .60 | .71* | .61 |
| 17. Adverb frequency | .32 | .60 | .47 | .43 | .43 | .38 |
| 18. Pronoun frequency | .36 | .39 | .44 | .49 | .39 | .49 |

Note.—The asterisk designates a correlation coefficient significant at $p < .01$. Each correlation is based on 11 paragraphs (N = 11).

From Table 6, it is apparent that there are three linguistic variables which bear the strongest relation to the tests: clause length, sentence length, and word difficulty. Furthermore, it is interesting that with few exceptions, these variables are highly correlated with all of the tests including both pre tests, both post tests, and both adjusted gain scores.

The high positive correlation between the linguistic characteristics and the pre tests is striking. For example, the correlation of -.83 between clause length and the pre multiple choice test scores signifies that children answered more multiple choice pre test questions correctly if the test covered passages which contained short clauses than if the test covered passages which contained lengthy clauses. This implies that written materials which treat highly familiar topics are composed with shorter clauses than written materials which treat unfamiliar topics. To generalize this relationship, complex grammatical structures appear to be used by writers when unfamiliar topics are being communicated whereas simpler grammatical structures are employed when the content of the communication is more familiar to the reader. For example, suppose a 12 year old American child does not know the meaning of either the word archer or matador. One might explain the word archer by saying, "it is someone who shoots a bow and arrow." The word matador, however, would require at least the statement that, "it is a person who fights a bull by waving a flag and dodging the bull's charge until he has a chance to kill the bull with a sword."

The multiple regression equations were developed from the data available in Table 6. For each of the test measures including pre

cloze, pre multiple choice, post cloze, post multiple choice, cloze gain and multiple choice gain, the linguistic variables which correlated significantly with the test were entered into a program to compute the stepwise regression equation for the test. For example, for the cloze gain score, the variables entered into the stepwise regression program were: clause length, sentence length, word difficulty and verb frequency. The variables entered in the multiple choice gain stepwise regression, however, were word difficulty and noun abstractness.

The results of the stepwise regression analysis for the learning measures are presented in Table 7.

TABLE 7

Stepwise Regression Analysis of Passage Characteristics and Learning Measures

| Dependent Variable | Independent Variable | Multiple R | Multiple RSQ | Increase in RSQ |
|---|---|---|---|---|
| Cloze Gain | Sentence Length | .842 | .710 | Significant |
| | Verb Frequency | .862 | .744 | NS |
| | Word Difficulty | .866 | .750 | NS |
| | Clause Length | .867 | .751 | NS |
| Multiple Choice Gain | Word Difficulty | .815 | .664 | Significant |
| | Noun Abstractness | .829 | .687 | NS |

In the stepwise regression procedure, the independent variable which is most highly correlated with the dependent variable is entered into the regression first. Second, the independent variable having the highest partial correlation with the dependent variable after the variance attributable to the first variable is removed is entered into the regression equation. All remaining variables are entered using the same criterion as the second variable.

As the Table 7 indicates, the independent variable of sentence length correlated .842 with the cloze gain scores. This variable accounted for .710 of the variance in the cloze gain scores, a significant ($p < .01$) proportion. The next three variables entered were verb frequency, word difficulty, and clause length in that order. However, none of these latter linguistic descriptors significantly increased the predictability of the cloze gain scores. Although all of the latter variables have significant zero order correlations with cloze gain, they are also highly correlated with sentence length which prevents them from improving the prediction of cloze gain over that provided by sentence length.

The multiple choice gain score was most highly correlated with word difficulty. The correlation was .815 and the proportion of variance in the multiple choice gain scores accounted for by the word difficulty was .664. Although noun abstractness was significantly correlated with multiple choice gain and consequently was entered into the stepwise regression, abstractness did not significantly improve the predictability of the multiple choice gain over that provided by word difficulty. Analagous to the case of the cloze gain, this second variable is highly correlated (.88) with the first independent variable, word difficulty,

and consequently it is unlikely to account for a different portion of the variance in the dependent variable than that accounted for by word difficulty.

The multiple regression of the linguistic characteristics on the post test scores is summarized in Table 8.

TABLE 8

Stepwise Regression Analysis of Passage Characteristics and Post Test Measures

| Dependent Variable | Independent Variable | Multiple R | Multiple RSQ | Increase in RSQ |
|---|---|---|---|---|
| Post Cloze | Sentence Length | .960 | .921 | Significant |
| | Word Difficulty | .961 | .924 | NS |
| | Verb Nominalization | .962 | .925 | NS |
| | Clause Length | .962 | .925 | NS |
| Post Multiple Choice | Word Difficulty | .869 | .756 | Significant |
| | Noun Abstractness | .874 | .763 | NS |
| | Sentence Length | .874 | .764 | NS |

The results of this analysis are virtually identical to those for the gain scores. For the post cloze measure, sentence length was most highly correlated and accounted for a significant proportion of the

variance (.92). The three other variables which were entered into the regression equation, word difficulty, verb nominalization and clause length, did not significantly increase the total proportion of variance in the dependent variable which could be accounted for. Note that sentence length was the only significant variable in the regression equation for the cloze gain scores and this pattern is repeated for the post cloze scores. The post multiple choice scores were correlated significantly with word difficulty, accounting for .756 of the variance. However, the other two variables, abstractness and sentence length, failed to significantly improve the prediction of post multiple choice scores. Note that this regression equation contains the same single predictor as the equation for the multiple choice gain variable. The importance of the similarity between the regression equations for the gain scores and the regression equations for the post test scores is that evidence is forwarded for the notion that the same linguistic characteristics which determine the extent to which all of the information in a passage is comprehended by the reader also determines the extent which new learning occurs on the part of the reader as a consequence of reading the passage. Further treatmentt of this topic will appear in the Discussion section.

The relationship between the characteristics of the pupils in the sample and their scores on the pre tests, post tests, and learning measures are presented in Table 9.

TABLE 9

Intercorrelations of Student Characteristics and Test Performance

| | Pre Multiple Choice | Pre Cloze | Post Multiple Choice | Post Cloze | Multiple Choice Gain | Post Gain |
|---|---|---|---|---|---|---|
| Reading Comprehension | .51 | .87* | .74* | .74* | .79* | .80* |
| Vocabulary | .62* | .84* | .31 | .68* | .66* | .81* |
| IQ | .63* | .77* | .47 | .87* | .77* | .68* |
| SES | -.23 | -.55 | -.19 | .03 | -.21 | -.43 |

Note.—* = $p < .01$. The reading comprehension and vocabulary measures were subtests on the Iowa Test of Basic Skills. The IQ Test was the Lorge-Thorndike; and the socio-economic status (SES) rating was based on the Hollingshead occupational scale.

One interesting pattern of relationships observable in this data is that reading comprehension skill as measured by the Iowa Test of Basic Skills has a high positive correlation with pre test performance, post test performance, and the adjusted gain scores. This suggests that students with relatively high reading abilities are superior to students with relatively low reading abilities on the amount of information known about the topics before the topics are read, the total amount of information contained in the passage which is comprehended by the student and the amount of new information which is acquired as a function of reading the passage.

It is also interesting to note that the SES of the students is not highly correlated with any of the tests or learning measures. The variables of reading, vocabulary and IQ are related to the tests and learning measures in a manner similar to reading comprehension, except

that the correlations with the post multiple choice test do not reach significance.

## Discussion

The focus of this investigation was the comparison of the learnability and readability of text materials. As outlined in the introduction, learnability refers to the extent to which a passage communicates new information to the reader; whereas readability refers to the likelihood that the contents of a passage will be comprehended by the reader regardless of whether any new learning occurs. Although a number of writers such as Bormuth (1966), Coleman & Miller (1968) and Dale & Chall (1948) have developed formulas which predict the readability of text materials, the study of learnability had not previously been undertaken. The critical issue raised here was whether the variables used in the readability formulas for the prediction of comprehension may also be used for the prediction of new learning or whether new variables must be identified for the estimation of learnability.

In the Dale-Chall index, the two linguistic characteristics used to estimate the readability of the materials are word difficulty and sentence length. In the present investigation it was found that new learning that results from reading as measured by cloze tests is correlated .76 with the word difficulty and .84 with the sentence length of the passages. Both of these correlations are significant, but adding word difficulty to sentence length as predictors in a multiple regression equation did not improve the prediction of learning over that

provided by sentence length alone. When new learning is measured by multiple choice tests, the linguistic variables of word difficulty and abstractness are significantly correlated with learning, but the two measures combined are not more predictive than one used alone. Thus the same variables which are contained in many readability formulas, including the Dale-Chall index, predict with considerable accuracy the amount of new learning which occurs as a result of reading. Materials which are judged to have high readability for a given age group will likely impart a substantial amount of learning to students of that age who read the materials.

In a readability study by Bormuth (1966) the linguistic characteristics or word length, clause length, sentence length, and word difficulty based on the Dale 3,000 list were significantly correlated with pre cloze tests. The findings of this study confirm these results. The same passage characteristics were significantly correlated with pre cloze tests, except that word length was correlated at a lower level of significance ($p < .05$) than the other measures. Furthermore, the following variables were present in both the Bormuth (1966) study and in this investigation and failed to correlate with pre cloze performance in either study: noun frequency, verb frequency, adverb frequency, adjective frequency, and pronoun frequency.

Comparison of this study with that of Coleman & Miller (1968) is also instructive. The Coleman & Miller investigation contained a learning measure which was based on the number of words in a passage guessed by the reader the first time he is presented the passage subtracted from the number of correct guesses the second time he is presented the passage. One variable which correlated significantly with that criterion and which also correlated significantly with the

cloze gain scores in this study was verb nominalization. However, the following variables were significantly correlated with the cloze gain score in this investigation, but were not related to the learning measure used by Coleman & Miller: word difficulty, sentence length, clause length, and verb frequency. The measure of learning used in this study was a pre test - post test difference with a reading period intervening. However, the Coleman & Miller measure had no reading period and is consequently inadequate as an index of knowledge gained from reading. Since the measure used in this investigation appears to be valid, the correlates may be viewed as dependable. The absence of correlation between linguistic traits and information gain in the Coleman & Miller study may be disregarded since the learning measure apparently lacks validity.

A provocative finding in this study was the high negative correlation between the linguistic complexity of text materials and the students' performance on pre tests over the materials. In other words, students had less prior knowledge of passages which contained highly complex linguistic structures. Concomitantly, this study showed that more learning occurs when the grammatical complexity is low than when the complexity is high. The resulting paradox is that unfamiliar reading material, for which a considerable amount of learning must occur, is written in a complex form which minimizes the likelihood that new learning will occur. On the other hand, reading material with which one is acquainted and for which little learning needs to occur is written in a form which maximizes the likelihood of learning. It would be useful to attempt to construct reading materials which communicate

unfamiliar topics with simple grammatical structures. In this manner the acquisition of unfamiliar bodies of knowledge might be facilitated. Future research should be addressed to the issue of which linguistic variables can be manipulated to affect learning from prose and how these variables may be combined to optimize the learnability of written materials.

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APPENDIX A

Linguistic Characteristics of Passages

| Linguistic Descriptor | Passage Number (grade equivalent) | | | | |
|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 6 |
| 1. Noun redundancy | .0667 | .3500 | .0526 | .4444 | .1250 |
| 2. Modifier redundancy | .1818 | 00 | 00 | .2083 | .1600 |
| 3. Noun abstractness | .0435 | 00 | .1053 | .0370 | .0625 |
| 4. Verb nominalization | 00 | 00 | 00 | .0370 | 00 |
| 5. Verb copula | .1053 | .1304 | .0192 | .0183 | .0403 |
| 6. Noun familiarity* | .8079 | 2.0538 | 1.2823 | 1.0837 | .9938 |
| 7. Verb familiarity* | 17.9752 | 12.6700 | 13.1778 | 6.8254 | 7.4481 |
| 8. Adjective familiarity* | 3.3690 | 1.6374 | 1.2453 | 4.4049 | 3.6738 |
| 9. Adverb familiarity* | 5.8790 | 2.4002 | 7.1070 | 7.5507 | 5.1993 |
| 10. Word length | 3.9123 | 4.1304 | 3.6827 | 4.4679 | 4.9530 |
| 11. Clause length | 24.7778 | 27.1429 | 34.8182 | 40.5833 | 49.2000 |
| 12. Sentence length | 27.8750 | 38.0000 | 42.5556 | 44.2727 | 73.8000 |
| 13. Word difficulty | .0175 | .0326 | .0385 | .0642 | .0872 |
| 14. Noun frequency | .1316 | .2174 | .1827 | .2477 | .2286 |
| 15. Adjective frequency | .0702 | .0978 | .1154 | .1651 | .1007 |
| 16. Verb frequency | .2105 | .2500 | .2019 | .1743 | .1611 |
| 17. Adverb frequency | .1228 | .0543 | .0385 | .0550 | .0671 |
| 18. Pronoun frequency | .6053 | .2308 | .4063 | .1000 | .4063 |

| | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|
| 1. | .1333 | .3611 | .1035 | .1714 | .4000 | .0312 |
| 2. | 00 | .1304 | .1500 | .1364 | .2174 | .0476 |
| 3. | .2333 | .1389 | .1935 | .3714 | .2000 | .3438 |
| 4. | .1000 | .0833 | .0645 | .0286 | .2250 | .3438 |
| 5. | .0261 | .0533 | .0094 | .0410 | .0533 | .0357 |
| 6.* | 3.0921 | .9162 | 1.1761 | 1.2382 | .7758 | .4777 |
| 7.* | 14.3678 | 3.7631 | 15.2155 | 13.7365 | 8.5711 | 19.9553 |
| 8.* | 2.8161 | 2.2562 | 2.0005 | 1.2825 | 5.1035 | 1.3491 |
| 9.* | 5.3911 | 2.4994 | 3.4892 | 2.3630 | 3.6025 | 2.4850 |
| 10. | 4.5478 | 4.5600 | 4.8019 | 4.9754 | 4.8400 | 4.2679 |
| 11. | 58.1111 | 62.1818 | 63.6250 | 55.1818 | 55.8462 | 79.6667 |
| 12. | 87.1667 | 85.5000 | 84.8333 | 75.8750 | 121.0000 | 119.5000 |
| 13. | .1130 | .1467 | .1792 | .2131 | .2067 | .2411 |
| 14. | .2609 | .2400 | .2925 | .2869 | .2667 | .2857 |
| 15. | .0783 | .1200 | .1415 | .1639 | .1267 | .1696 |
| 16. | .1652 | .1800 | .1038 | .1557 | .1800 | .0982 |
| 17. | .0696 | .0333 | .0472 | .0164 | .0267 | .0179 |
| 18. | .2683 | .1429 | .1212 | .0571 | .1000 | .1250 |

Note.—* = in thousandths.

APPENDIX B

Reading Passages

(Numbered according to grade equivalent)

2. You cannot see it, but it is all around you. It touches the floor and the ceiling and the walls. It is inside your desk. It is between your fingers and between your toes. It is inside your mouth. It is between the pages of this book. It is always pushing on you with great force. But usually you do not feel it pushing. Sometimes it moves very fast. Sometimes it stands still. Sometimes it is warm. Sometimes it is cold. It is worth more to you than gold, but it costs nothing at all. What is it? You are almost sure to have guessed the answer to the riddle. The answer is "Air."

3. It is night time. In the house Susie is asleep. Next to the bed her dolls are tucked in their cribs and her puppy is curled up on the rug. He is sleeping, while Susie sleeps. Downstairs in the living room, Susie's Daddy and Mommy are awake. Some friends are visiting them. They are talking about grownup things. Soon they will be sleepy too. The friends will go home and Mommy and Daddy will go upstairs and peep into Susie's room. Then they will go to bed and sleep while Susie sleeps.

4. Horatio was a cat. He was a middle-aged, striped cat, rather fat. He had gray eyebrows that stuck out and made him look cross. He did

not like to be picked up and hugged and he seldom purred. He liked to be treated with respect. He lived with a lady named Mrs. Casey, in a brick house on a city street. She took good care of him. She gave him the very best liver, in a handsome bowl under the kitchen table. He had his own chair in front of the fire, and at night he slept on the end of Mrs. Casey's bed.

5. Three small goldfish, six big snails, and one wiggly tadpole all lived together. You may think that these animals were very strange. The snails could not get out of their houses. The goldfish never shut their eyes. The snails stuck out their tongues when they ate. The goldfish opened and closed their mouths all day long. The tadpole had a strange way of swimming. He just wiggled and wiggled and wiggled his tail. The goldfish, the snails, and the one wiggly tadpole lived in an aquarium. A dozen green water plants lived in the aquarium too. An aquarium is a place where water animals and water plants live.

6. We were all ready for the trail with our packs strapped on securely. We followed the trail nearly all day except when we stopped to lunch by the side of a high cliff. By sundown we were anxiously looking for a place to camp for the night. We gathered a huge stack of eucalyptus branches to have ready for our fire. After supper we rolled up in our blankets near the fire and we were soon asleep. We were awakened by very queer sounds which my friend recognized as howls of a jaguar. We hastily heaped more branches on the fire that was burning low. We played our ukuleles and sang. By means of much light and noise we kept

all creatures away except an inquisitive deer and several rabbits and squirrels. We fell asleep toward dawn and we were not bothered again during our stay in the canyon.

7. I was born in Tuckahoe, near Hillsborough, and about 12 miles from Easton, in Talbot county, Maryland. I have no accurate knowledge of my age, never having seen any authentic record containing it. By far the larger part of the slaves know as little of their age as horses know of theirs, and it is the wish of most masters within my knowledge to keep their slaves thus ignorant. I do not remember to have ever met a slave who could tell of his birthday. They seldom come nearer to it than planting-time, harvest-time, cherry-time, spring-time, or fall-time. A want of information concerning my own was a source of unhappiness to me even during childhood.

8. The electric eel, a native fish of South America, defends itself from attacks of enemies by a natural electric battery. A discharge from this battery is powerful enough to stun even the largest animals. Where roads pass through ponds frequented by these peculiar fish, it has often been found necessary to change the line of the road for fear of them. These fish are used for food by the native Indians, but they are dangerous to catch because of their ability to shock the fishermen. In order to overcome this difficulty, the Indians have devised a very ingenious method of disarming the fish. Horses are driven into the ponds and the eels expend their electrical charge on the horses. Then the fish are easily harpooned and caught. It is

only after a long rest and some food that they are able to build up ability to shock their enemies again.

9. Negro slavery once was present in every English colony in America. In some of these colonies it never had much popularity. By the time of the Revolution, slavery had practically disappeared north of the Mason and Dixon line - the surveyed boundary between Pennsylvania and Maryland. Below that line, every colony had slaves by the thousands. When the thirteen original states set up their governments, the seven to the north forbade slavery, while the six to the south permitted it. A few years later, in the Northwest Ordinance, Congress voted that slavery should never exist in the part of the American West north of the Ohio.

10. During recent wars, particularly World War II, some of our individual freedoms were given sharp setbacks. This was done in the name of national security. Freedom of speech sometimes suffered. For example, some people with unpopular views were denied the right to speak at certain universities and in some public places. Even religious freedom suffered. For example, some states required a loyalty test oath of churches before they could continue to have property tax exemption. These cutbacks on the freedoms came at a time when the United States was the most powerful nation in the world. In remarkable contrast, when our nation was new-born and the weakest in the world our forefathers insisted on setting up and living by our Bill of Rights.

11. Space is said to be pervaded by ether, an invisible medium by which all waves of energy are thought to be transmitted. Of these ethereal vibrations, the most important for plants are the light waves, since all plants grow by the action of light, which a substance in their leaves converts into energy. Various species of plants, however, thrive best on different varieties of what we call light. For example, there is a marked difference between sunlight and moonlight, owing to the fact that the vibrations of light from the sun run in all directions, but the vibrations of moonlight are polarized and run in one direction only. Certain plants such as the cucumber, thrive best in this polarized light. Since the discovery of this scientific fact, various experimental farms have been established where the light has been polarized in order to further the growth of certain species of plants.

12. By the 1860's the American workingman had learned that so far as he was concerned, the most important effect of industrialization was the transformation of the skilled craftsman into a factory worker. The consequences of this change for the worker included: (1) the loss of the bargaining power that his skills and tools had given him; (2) the impersonality of employer-employee relations in the new corporations; and (3) the increased competition for jobs resulting from a nation-wide labor market and large-scale immigration. For unskilled laborers a working day of ten hours or more and weekly wages of $10.00 or less were common. Working conditions in factories, sweatshops, and mines were unhealthy and often dangerous.

APPENDIX C

Multiple Choice Tests

(Correct answers are underlined.)

II.

1. What does this article say air touches?

   a) The floor, ceiling and walls.

   b) The desk.

   c) Your fingers and toes.

   d) The pages of the book.

2. What does the article say air is between?

   a) Your fingers and toes.

   b) The floor and ceiling.

   c) The two sides of your desk.

   d) The ceiling and walls.

3. What does the article say air is inside of?

   a) Only your desk.

   b) Only your mouth.

   c) Both your mouth and desk.

   d) Neither your mouth nor your desk.

4. What is this article about?

   a) Water.

   b) Air.

   c) Weather.

   d) Rooms.

5. What is the answer to the riddle?

   a) Everywhere.

   b) Gold.

   c) Always changes.

   d) Air.

6. How does air change?

   a) It is sometimes warm and sometimes cold.

   b) It is sometimes worth more than gold and sometimes not.

   c) It is sometimes in your desk and sometimes outside of it.

   d) It sometimes touches the floor and sometimes not.

7. What is true about air?

   a) You can always see air.

   b) You usually cannot see air.

   c) You can usually feel air pushing on you.

   d) You have to buy air.

8. What does the author think?

   a) That you will definitely not guess the answer to the riddle.

   b) That you will probably not guess the answer to the riddle.

   c) That you will probably guess the answer to the riddle.

   d) That you will definitely guess the answer to the riddle.

III.

1. What time is it in this story?

   a) Morning.

   b) Afternoon.

   c) Evening.

   d) Night-time.

2. Where is Susie's puppy?

   a) On the rug.

   b) In the crib.

   c) On Susie's bed.

   d) Downstairs.

3. Where are Susie's parents?

   a) With Susie.

   b) In their bedroom.

   c) In the kitchen.

   d) In the living room.

4. Right before they go to bed what will Susie's parents do?

   a) They will tuck Susie in.

   b) They will peep into Susie's room.

   c) They will drive their friends home.

   d) They will bring the puppy upstairs.

5. What are Daddy, Mommy, and their friends talking about?

   a) Susie and other children.

   b) Grownup things.

   c) What to do about the puppy.

   d) Trips they will take for their vacations.

6. Where is Susie's room?

   a) Upstairs.

   b) Downstairs.

   c) The story does not say.

   d) In the same room as her Mommy and Daddy.

7. Where will the friends sleep?

   a) In the living room.

   b) In Susie's room.

   c) In their own home.

   d) In a hotel.

8. What do we know for sure is in Susie's room?

   a) A bed, cribs, and a rug.

   b) A bed, cribs, a rug, and a chest of drawers.

   c) A bed, cribs, a rug, a chest of drawers and a closet.

   d) A bed, cribs, a rug, a chest of drawers, a closet and a mirror.

IV.

1. What is Horatio's age?

   a) He is young.

   b) He is teen-aged.

   c) He is middle-aged.

   d) He is old.

2. What does Horatio like?

   a) To be treated with respect.

   b) To purr.

   c) To be picked up.

   d) To be treated with love.

3. How do we know that his owner takes good care of Horatio?

   a) She picks him up.

   b) She gives him the best liver.

   c) She gives him his own bed.

   d) She pets him.

4. What makes Horatio look cross?

   a) His age.

   b) His stripes.

   c) His fatness.

   d) His eyebrows.

5. What was Horatio?

a) Slim.

b) Midium-sized.

c) Rather fat.

d) Very fat.

6. Who did Horatio live with?

a) Mrs. Casey.

b) Mrs. O'Malley.

c) Mrs. Neil.

d) Mrs. Jones.

7. Where did Horatio eat?

a) In a chair.

b) At the end of his owner's bed.

c) In front of the fire.

d) Under the kitchen table.

8. What color were Horatio's eyebrows?

a) Gray.

b) Black.

c) White.

d) Brown.

V.

1. Which is true?

   a) The tadpole never opened his eyes.

   b) The tadpole stayed in his house.

   c) The tadpole wiggled his tail.

   d) The tadpole opened and closed his mouth.

2. Which is true?

   a) The snails have a strange way of swimming.

   b) The snails open and close their mouths all day.

   c) The snails eat with their tongues stuck out.

   d) The snails could get out of their houses.

3. Which animals in the story eat with their tongues stuck out?

   a) The snails.

   b) The crayfish.

   c) The frogs.

   d) The mudslingers.

4. Which animal has a strange way of simming?

   a) The crayfish.

   b) The guppy.

   c) The frog.

   d) The tadpole.

5. What is the aquarium in the story?

   a) A place where water animals and water plants live together.

   b) A place where only water animals live.

   c) A place where the different water animals cannot live together.

   d) A place where only water plants live.

6. How many goldfish are there in the story?

   a) 1.

   b) 3.

   c) 6.

   d) 12.

7. What animals live in the aquarium?

   a) Only a tadpole, snails, and goldfish.

   b) Only a tadpole, snails, goldfish, and crayfish.

   c) Only a tadpole, snails, goldfish, crayfish, and a guppy.

   d) Only a tadpole, snails, goldfish, crayfish, a guppy, and a mudslinger.

8. Who owns the aquarium?

   a) A group of children in school.

   b) A scientist.

   c) A family.

   d) The story does not say.

VI.

1. Where are the people in the story?

   a) They are on a camping trip.

   b) They are going swimming.

   c) They are going hunting.

   d) They are going skiing.

2. What are the people in the story awakened by?

   a) Deer, rabbits and squirrels.

   b) The cold.

   c) The rain.

   d) The howls of a jaguar.

3. How did the people protect themselves?

   a) By walking quickly away.

   b) By building a fire and singing.

   c) By finding a safe place to stay.

   d) By building a shelter.

4. What did the people do during the day?

   a) They stopped many times to rest.

   b) They stopped twice for lunch and sleep.

   c) They stopped just for lunch.

   d) They stopped only to sleep.

5. What instruments did the people play?

a) Guitars.

b) Ukuleles.

c) Harmonicas.

d) Banjos.

6. What type of plant do we know the people saw?

a) Maple.

b) Sassafras.

c) Oak.

d) Eucalyptus.

7. What animals were not frightened by fire?

a) Jaguars.

b) Bears.

c) Deer.

d) Leopards.

8. Where did the people eat lunch?

a) On top of a cliff.

b) On the side of a cliff.

c) Halfway up a cliff.

d) The people did not stop to lunch.

VII.

1. What does the author of this article not know?

   a) Where he was born.

   b) His age.

   c) Why he was unhappy as a child.

   d) Masters who keep their slaves' ages a secret.

2. According to the author what do most masters want to do?

   a) They want to teach their slaves a lot.

   b) They want to keep their slaves ignorant of some things.

   c) They want to tell their slaves when they were born.

   d) They try to keep slaves from knowing where they live.

3. What was one of the reasons why the author was unhappy when he was a child?

   a) He lived in Maryland.

   b) He could not tell when it was planting-time.

   c) He did not know his age.

   d) His master made him learn too much.

4. Why does the author compare slaves and horses?

   a) He wishes to show that slaves work as hard as horses.

   b) He wishes to show that slaves are as stupid as horses.

   c) He wishes to show that slaves are treated like horses.

   d) He wishes to show that slaves are as ignorant as horses about some things.

5. What was the author?

a) A free man who was not a master.

b) A master.

c) A slave.

d) The story does not tell you.

6. What county was the author born in?

a) Tuckahoe.

b) Talbot.

c) Hillsborough.

d) The story does not say.

7. Who does the author say he never met?

a) A slave who knew his birthday.

b) A slave who was happy.

c) A slave who knew when it was planting-time.

d) A slave who knew where he was born.

8. What does this story let you know about slaves?

a) They are carpenters.

b) They work in steel mills.

c) They were farmers.

d) The story does not say.

VIII.

1. What can the electric eels do?

   a) They can defend themselves by an electric shock.

   b) They can shock their enemies over and over in a few minutes.

   c) They can keep Indians from eating them.

   d) They can stun only small animals.

2. What happens because the eels are dangerous?

   a) Indians do not harpoon them.

   b) Indians do not let their horses go near them.

   c) Roads are changed so they do not go through the eels' ponds.

   d) The eels' ponds are dried out.

3. What have the Indians learned about the eels?

   a) The eels cannot be used for food because they can give electric shocks.

   b) Eels cannot shock horses.

   c) It is always necessary to change roads which go through eels' ponds.

   d) Eels need food and rest before they give a second shock.

4. Where does this article say eels come from?

   a) The oceans.

   b) Greenland's rivers.

   c) South American ponds.

   d) North American lakes.

5. What does the story tell you about the work Indians do?

a) They are fishermen.

b) They are hunters.

c) They are trappers.

d) All of the above.

6. What does the story let you know about the Indians?

a) They are not very smart.

b) They have average intelligence.

c) They are ingenious in some ways.

d) The story does not say.

7. What does this story say about the Indians.

a) They do not get along with white men.

b) They live in peace with white men.

c) They like the white men.

d) The story does not say.

8. Why do the eels shock people and animals.

a) They want to use them for food.

b) They need to protect themselves from attack.

c) They just happen to do this.

d) The story does not say.

IX.

1. In America Negro slavery:

   a) Once existed in every colony.

   b) Never existed in the north.

   c) Was very unpopular during the Revolution.

   d) Was not forbidden by any of the original 13 states when they first set up their governments.

2. What did the Northwest Ordinance say?

   a) That there should be no slavery North of the Mason and Dixon line.

   b) That seven northern states had to forbid slavery.

   c) That slavery should never exist in the West north of the Ohio.

   d) That slavery should never exist.

3. Which is true?

   a) Only the South liked slavery.

   b) Once slavery existed in all the English colonies in America, but soon slavery was forbidden in many places.

   c) During the Revolution Congress voted that there should be no more slavery.

   d) By the time of the Revolution slavery had practically disappeared in the U.S..

4. Where was slavery the most popular in the U.S.?

   a) North of the Mason and Dixon line.

   b) The West north of the Ohio.

   c) South of the Mason and Dixon line.

   d) Pennsylvania and Maryland.

5. What country does this story say had colonies in America?

   a) Spain.

   b) France.

   c) England.

   d) The story does not say.

6. What states does this article tell you are separated by the Mason and Dixon line?

   a) Delaware and Maryland.

   b) Pennsylvania and Delaware.

   c) Maryland and Pennsylvania.

   d) Maryland and Virginia.

7. When was the Northwest Ordinance passed?

   a) Before the Revolution.

   b) When the states first set up their governments.

   c) A few years after the states first set up their governments.

   d) During the Civil War.

8. Of the original 13 states, how many were northern?

   a) 8.

   b) 7.

   c) 6.

   d) 5.

X.

1. When were some American freedoms taken away?

   a) When the U.S. was new-born.

   b) When the U.S. was the weakest nation in the world.

   c) When the U.S. was not very powerful.

   d) During some recent wars.

2. Some people said these freedoms had to be taken away because of what?

   a) National security had to be protected.

   b) The U.S. was not very powerful.

   c) Churches did not have to pay certain taxes.

   d) The U.S. was the most powerful nation.

3. What is an example of how freedom of speech suffered?

   a) Churches had to take loyalty oaths.

   b) Some people with unpopular views could not speak at certain universities.

   c) Churches did not have tax exemptions.

   d) Our nation was weak.

4. The contrast spoken of in this article is between what two things?

   a) Times of war and times of peace.

   b) Times of freedom of speech and times of freedom of religion.

   c) Times of individual freedom and times when our national security is in danger.

   d) Times when our nation was new and weak and recent times when our nation was powerful.

5. What does the Bill of Rights protect?

   a) Freedom of speech.

   b) Freedom of religion.

   c) Individual freedoms.

   d) All of these.

6. Where does this article say people with unpopular views could not speak?

   a) On some radio stations.

   b) On some television channels.

   c) In some newspapers.

   d) At some univerisities.

7. How does this article say religious freedom suffered?

   a) People with unpopular views could not speak in some places.

   b) No church could have property tax exemptions.

   c) All churches had to take loyalty oaths to have property tax exemptions.

   d) Some states said churches had to take loyalty oaths to have property tax exemptions.

8. Who wanted churches to take loyalty oaths?

   a) Some states.

   b) The national government.

   c) Our forefathers.

   d) None of the above.

XI.

1. What makes light waves important for plants?

   a) They are transmitted by ether.

   b) They are polarized.

   c) They are converted into energy.

   d) They are ethereal vibrations.

2. Moonlight differs from sunlight because of what?

   a) Only sunlight is needed by plants.

   b) The vibrations of sunlight are polarized.

   c) The vibrations of moonlight run in only one direction.

   d) The vibrations of sunlight run in only one direction.

3. Scientists can further the growth of certain species of plants by doing what?

   a) By increasing the amount of ether in space.

   b) By polarizing light.

   c) By converting light into energy.

   d) By growing cucumbers in sunlight.

4. Which is true?

   a) Scientists can polarize light.

   b) Scientists cannot polarize light.

   c) Both sunlight and moonlight are polarized.

   d) The cucumber grows best in sunlight.

5. What is space said to be pervaded by?

   a) Polarized light.

   b) Waves of energy.

   c) Ether.

   d) Ethereal vibrations.

6. When light is polarized it:

   a) Is converted to energy.

   b) Runs in all directions

   c) Runs in one direction,

   d) Cannot be converted to energy.

7. According to this article which plants grow best in polarized light?

   a) Tulips.

   b) Eucalyptus.

   c) Cactus.

   d) None of the above.

8. What is ether?

   a) A medium to transmit light.

   b) A medium to polarize light.

   c) A medium to convert light to energy.

   d) The article does not tell you.

XII.

1. By the 1860's what was the most important effect of industrialization?

   a) Working conditions improved.

   b) Skilled craftsmen were replaced by factory workers.

   c) The workers' skills helped them get better wages.

   d) There were jobs for almost everyone.

2. By the 1860's what did industrialization lead to?

   a) Greater bargaining power for workers.

   b) More personal relations between employers and employees.

   c) More competition for jobs.

   d) Weekly wages for unskilled laborers becoming about $100.00 or less.

3. By the 1860's working conditions in factories had become what?

   a) Healthier because of industrialization.

   b) Unhealthy because of immigration.

   c) Healthier because there were more workers to share the work.

   d) Unhealthy because of industrialization.

4. Which of the following is true?

   a) Immigration led to less competition for jobs.

   b) Factory workers can better use their skills and tools to bargain with than can the skilled craftsmen.

   c) By the 1860's the relations between employer and employee became impersonal.

   d) Indistrialization led to improved working conditions by the 1860's.

5. By the 1860's what were common weekly wages for unskilled workers?

   a) $100.00 or less.

   b) $70.00 or less.

   c) $30.00 or less.

   d) $10.00 or less.

6. By the 1860's about how many hours a day did most laborers work?

   a) 14.

   b) 12.

   c) 10.

   d) 8.

7. What gives workers bargaining power?

   a) Skills and tools.

   b) Impersonal employer-employee relations.

   c) A nation-wide labor market.

   d) Immigration.

8. What country is this article speaking about?

   a) England.

   b) America.

   c) France.

   d) All industrial countries.

APPENDIX D

Cloze Tests

2. You cannot see it, _____it is all around _____. It touches the floor _____ the ceiling and the _____. It is inside your _____. It is between your _____ and between your toes. _____ is inside your mouth. _____ is between the pages _____this book. It is _____ pushing on you with _____ force. But usually you _____ not feel it pushing. _____ it moves very fast. _____ it stands still. Sometimes _____ is warm. Sometimes it _____ cold. It is worth _____ to you than gold, _____ it costs nothing at _____. What is it? You _____ almost sure to have _____ the answer to the _____. The answer is "Air."

3. It is night time. _____ the house Susie is _____. Next to the bed _____ dolls are tucked in _____ cribs and her puppy _____ curled up on the _____. He is sleeping, while _____ sleeps. Downstairs in the _____ room, Susie's Daddy and _____ are awake. Some friends _____ visiting them. They are _____ about grownup things. Soon _____ will be sleepy too. _____ friends will go home _____ Mommy and Daddy will _____ upstairs and peep into _____ room. Then they will _____ to bed and sleep, _____ Susie sleeps.

4. Horatio was a cat. _____ was a middle-aged, striped _____, rather fat. He had _____ eyebrows that stuck out _____ made him

look cross. _____ did not like to _____ picked up and hugged _____ he seldom purred. He _____ to be treated with _____. He lived with a _____ named Mrs. Casey in _____ brick house on a _____ street. She took good _____ of him. She game _____ the very best liver, _____ a handsome bowl under _____ kitchen table. He had _____ own chair in front _____ the fire, and at _____ he slept on the _____ of Mrs. Casey's bed.

5. Three small goldfish, six _____ snails, and one wiggly _____ all lived together. You _____ think that these animals _____ very strange. The snails _____ not get out of _____ houses. The goldfish never _____ their eyes. The snails _____ out their tongues when _____ ate. The goldfish opened _____ closed their mouths all _____ long. The tadpole had _____ strange way of swimming. _____ just wiggled and wiggled _____ wiggled his tail. The _____, the snails, and the _____ wiggly tadpole lived in _____ aquarium. A dozen green _____ plants lived in the _____ too. An aquarium is _____ place where water animals _____ water plants live.

6. We were all ready _____ the trail with our _____ strapped on securely. We _____ the trail nearly all _____ except when we stopped _____ lunch by the side _____ a high cliff. By _____ we were anxiously looking _____ a place to camp _____ the night. We gathered _____ huge stack of eucalyptus _____ to have ready for _____ fire. After supper we _____ up in our blankets _____

the fire and we _____ soon asleep. We were _____ by very queer sounds _____ my friend recognized as _____ of a jaguar. We _____ heaped more branches on _____ fire that was burning _____. We played our ukuleles _____ sang. By means of _____ light and noise we _____ all creatures away except _____ inquisitive deer and several _____ and squirrels. We fell _____ toward dawn and we _____ not bothered again during _____ stay in the canyon.

7. I was born in _____, near Hillsborough, and about _____ miles from Easton, in _____ county, Maryland. I have _____ accurate knowledge of my _____, never having seen any _____ record containing it. By _____ the larger part of _____ slaves know as little _____ their age as horses _____ of theirs, and it _____ the wish of most _____ within my knowledge to _____ their slaves thus ignorant. _____ do not remember to _____ ever met a slave _____ could tell of his _____. They seldom come nearer _____ it than planting-time, harvest-time, _____, spring-time, or fall-time. A _____ of information concerning my _____ was a source of _____ to me even during _____.

8. The electric eel, a _____ fish of South America, _____ itself from attacks of _____ by a natural electric _____. A discharge from this _____ is powerful enough to _____ even the largest animals. _____ roads pass through ponds _____ by these peculiar fish, _____ has often been found _____ to change the line _____ the road for fear _____ them. These fish are _____ for food by the

_____ Indians, but they are _____ to catch because of _____ ability to shock the _____. In order to overcome _____ difficulty, the Indians have _____ a very ingenious method _____ disarming the fish. Horses _____ driven into the ponds _____ the eels expend their _____ charge on the horses. _____ the fish are easily _____ and caught. It is _____ after a long rest _____ some food that they _____ able to build up _____ to shock their enemies _____.

9. Negro slavery once was _____ in every English colony _____ America. In some of _____ colonies it never had _____ popularity. By the time _____ the Revolution, slavery had _____ disappeared north of the _____ and Dixon line - the _____ boundary between Pennsylvania and _____. Below that line, every _____ had slaves by the _____. When the thirteen original _____ set up their governments, _____ seven to the north _____ slavery, while the six _____ the south permitted it. _____ few years later, in _____ Northwest Ordinance, Congress voted _____ slavery should never exist _____ the part of the _____ West north of the _____.

10. During recent wars, particularly _____ War II, some of our _____ freedoms were given sharp _____. This was done in _____name of national security. _____ of speech sometimes suffered. _____ example, some people with _____ views were denied the _____ to speak at certain _____ and in some public _____. Even religious freedom suffered. _____ example, some states required _____ loyalty test oath of _____ before they could continue _____ have

property tax exemptions. _____ cutbacks on the freedoms _____ at a time when _____ United States was the _____ powerful nation in the _____. In remarkable contrast, when _____ nation was new-born and _____ weakest in the world _____ forefathers insisted on setting _____ and living by our _____ of Rights.

11. Space is said to _____ pervaded by ether, an _____ medium by which all _____ of energy are thought _____ be transmitted. Of these _____ vibrations, the most important _____ plants are the light _____, since all plants grow _____ the action of light, _____ a substance in their _____ converts into energy. Various _____ of plants, however, thrive _____ on different varieties of _____ we call light. For _____ there is a marked _____ between sunlight and moonlight, _____ to the fact that _____ vibrations of light from _____ sun run in all _____ , but the vibrations of _____ are polarized and run _____ one direction only. Certain _____ such as the cucumber, _____ best in this polarized _____. Since the discovery of _____ scientific fact, various experimental _____ have been established where _____ light has been polarized _____ order to further the _____ of certain species of _____.

12. By the 1860's the _____ workingman had learned that _____ far as he was _____, the most important effect _____ industrialization was the transformation _____ the skilled craftsman into _____ factory worker. The consequences _____ this change for the _____

included: (1) the loss of _____ bargaining power that his _____ and tools had given _____; (2) the impersonality of employer-_____ relations in the new _____; and (3) the increased competition _____ jobs resulting from a _____ labor market and large-scale _____. For unskilled laborers a _____ day of ten hours _____ more and weekly wages _____ $10.00 or less were _____. Working conditions in factories, _____, and mines were unhealthy _____ often dangerous.